3. Base Case Forecast

3.1. Introduction

This chapter describes the Base Case or "business as usual" forecast developed for New Hampshire using the ENERGY2020 and REMI (Regional Economic Models, Inc.) models. More details on how each model works can be found in Appendices 2 and 3. ENERGY2020 forecasts demands by economic sectors (residential, commercial, industrial, and transportation). Section 3.1 provides an overview of the Base Case forecast. Sections 3.2 through 3.5 provide further detail related to the residential, commercial, industrial, and transportation sectors.

The Base Case forecast is an attempt to project a most likely or "best guess" future trajectory of the energy and economic system in New Hampshire, for the purposes of stimulating ideas for potential policies, and testing for the expected impacts of potential policies.

The Base Case forecast is based in part upon forecasts of global fossil fuel prices from the US Department of Energy's Energy Information Administration (EIA). EIA is currently forecasting prices to be very stable, with slight declines in real prices (that is, prices expressed in constant dollars such as year 2000 dollars) projected over the next twenty years. Historically, however, fossil fuel prices have shown periods of great volatility, largely due to geopolitical events. As a result, it was suggested in stakeholder discussions that the policy simulations conducted should consider a hypothetical scenario in which fossil fuel prices followed historical patterns of volatility, rather than only the EIA projections of stability and modest decline. This hypothetical "high price" scenario allows us to test potential energy policies against both the Base Case forecast and an alternative hypothetical price spike event. Section 3.4 describes the alternative fuel price scenario and the effects of these alternative fuel prices upon key variables relative to the base case forecast.

3.2 Base Case Forecast Overview

The Base Case forecasts energy demand using economic drivers, energy prices, and the model's calculations of the costs and benefits of investments in energy efficiency. Economic drivers of New Hampshire's energy demand include personal income, commercial output, and industrial output. The energy prices consist of the wellhead price of gas, the world price of oil, and the minemouth price of coal.

Electricity prices are calculated with data drawn from the model (Appendix 2 has more information on how the model calculates this data).

Overall, the Base Case projects that total New Hampshire energy demand is expected to grow at an average rate of 2.2% annually between 2000 and 2020. Oil, the fuel with the highest demand, is forecasted to grow at only 2.0% per year, while electricity and natural gas grow at 3.1% and 3.2% respectively. It is important to note that this projection shows that the use of energy is forecast to grow at rates well above the growth in population (projected to be <1%), meaning that we will see an increase in energy use per capita over the next 20 years.

Figure 3.1 Secondary Fuel Demands (TBtu)

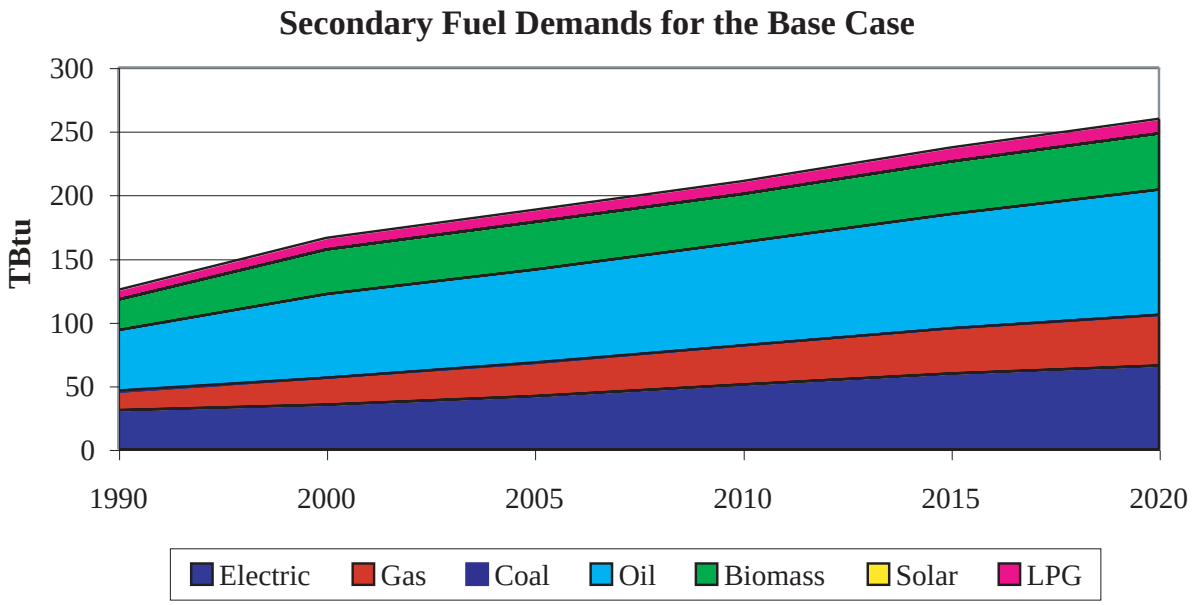

Figure 3.1 depicts the Base Case forecast of New Hampshire's secondary energy demand by fuel. Secondary energy demand refers to energy consumed at point of final use; for example, it includes the electricity we use to power our homes and business. By contrast, primary energy demand includes all energy at point of first use, which consists of the use of fuels at power plants to generate electricity, as well as to heat our homes. As a result, some fuels, such as natural gas that is used both to heat homes and to generate electricity, is included in both definitions. We use both definitions in order to understand how we use fuels overall, as well as how much electricity we use and how it is generated. For further detail, Table 3.1 below lists forecasted secondary demands and their growth rates.

Table 3.1 Secondary Fuel Demands (TBtu/Yr)

Base Case Forecast Secondary Fuel Demands (TBtu/Yr)						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Electric	30.64	35.07	41.95	50.91	59.57	65.64
Gas	14.45	21.19	25.93	30.46	35.45	40.11
Coal	0.83	0.04	0.04	0.04	0.04	0.04
Oil	47.78	65.44	73.32	81.22	89.86	98.03
Biomass	23.71	35.20	37.12	38.06	41.15	44.39
Solar	0.00	0.00	0.00	0.00	0.00	0.00
LPG	7.64	8.99	9.60	10.16	10.86	11.64
Total	**125.05**	**165.93**	**187.96**	**210.86**	**236.93**	**259.85**
	Cumulative Growth Rate (%)					
Electric	1.4%	0.0%	3.6%	3.7%	3.5%	3.1%
Gas	3.8%	0.0%	4.0%	3.6%	3.4%	3.2%
Coal	-29.9%	0.0%	-0.9%	-1.1%	-0.8%	-0.5%
Oil	3.1%	0.0%	2.3%	2.2%	2.1%	2.0%
Biomass	4.0%	0.0%	1.1%	0.8%	1.0%	1.2%
Solar	0.0%	0.0%	0.0%	-0.3%	0.2%	0.8%
LPG	1.6%	0.0%	1.3%	1.2%	1.3%	1.3%
Total	**2.8%**	**0.0%**	**2.5%**	**2.4%**	**2.4%**	**2.2%**

Table 3.2 shows the forecast of primary energy consumption, expected to increase at a rate of 1.66%. Natural gas is projected to grow at a much faster rate than oil (4.39% compared to 1.85%). As a result, the model projects a shift in consumption from oil to gas over the twenty year forecast period. This growth is largely due to the construction of new combined cycle gas plants for electric generation.

Table 3.2 Primary Energy Consumption (TBtu/Yr)

Base Case Forecast Primary Energy Consumption (TBtu/Yr)						
	1995	**2000**	**2005**	**2010**	**2015**	**2020**
Gas	33.159	86.232	129.121	152.085	184.384	207.514
Coal	21.148	60.701	56.872	60.142	60.455	60.697
Oil	61.801	116.509	121.637	140.705	156.036	168.637
Biomass	31.726	46.765	47.299	42.575	45.825	48.758
Solar	0.004	0.004	0.004	0.004	0.004	0.005
LPG	8.215	8.992	9.599	10.164	10.860	11.642
Hydro/Nuclear	46.694	144.682	149.423	149.423	149.423	149.423
Total	**202.746**	**463.884**	**513.954**	**555.098**	**606.986**	**646.676**
	Cumulative Growth Rate (%)					
Gas	19.11%	0.00%	8.07%	5.67%	5.07%	4.39%
Coal	21.09%	0.00%	-1.30%	-0.09%	-0.03%	0.00%
Oil	12.68%	0.00%	0.86%	1.89%	1.95%	1.85%
Biomass	7.76%	0.00%	0.23%	-0.94%	-0.14%	0.21%
Solar	-0.52%	0.00%	0.00%	-0.27%	0.17%	0.85%
LPG	1.81%	0.00%	1.31%	1.23%	1.26%	1.29%
Hydro/Nuclear	22.62%	0.00%	0.64%	0.32%	0.21%	0.16%
Total	**16.55%**	**0.00%**	**2.05%**	**1.80%**	**1.79%**	**1.66%**

Table 3.3. New Hampshire Economic Summary

Base Case Forecast New Hampshire Economic Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Employment (Thousands)	571.94	699.80	741.20	777.13	813.02	842.42
Population (Millions)	1.11	1.22	1.28	1.34	1.41	1.48
Nominal Dollars						
GRP (B$)	24.02	51.16	72.49	99.15	132.20	172.18
Personal Income (B$)	23.03	39.86	49.63	62.60	78.25	96.86
Disposable Income/Capita ($)	23,885	37,753	46,352	57,675	70,626	85,539
2000 Dollars						
GRP (2000 B$)	31.85	51.16	63.76	75.96	88.22	100.08
Personal Income (2000 B$)	30.54	39.86	43.65	47.95	52.22	56.30
Disposable Income/Capita (2000 $)	31,673	37,753	40,771	44,185	47,131	49,721
Cumulative Growth Rate (%)						
Employment	2.02%	0.00%	1.15%	1.05%	1.00%	0.93%
Population	0.92%	0.00%	1.04%	0.99%	0.98%	0.98%
GRP	4.74%	0.00%	4.41%	3.95%	3.63%	3.36%
Personal Income	2.66%	0.00%	1.82%	1.85%	1.80%	1.73%
Disposable Income/Capita	1.76%	0.00%	1.54%	1.57%	1.48%	1.38%

Economic growth largely influences the energy demand growth shown above. Table 3.3 summarizes the key economic indicators in the Base Case, which all show growth over the forecast period. Gross Regional Product (GRP) grows by 3.36%; personal income grows by 1.73%; and disposable income per capita grows by 1.38%. Employment and population also increase modestly at .93% and .98% respectively.

In addition to impacting the overall economy, energy prices also act as drivers on energy demand. Table 3.4 summarizes the Base Case projections of the prices of primary fuels. After a significant price spike in the year 2000, the energy prices settled back and are forecasted to have very little growth in real terms. The wellhead price of gas increases 0.9%, while the world oil price increases 0.3%. It should be noted that there is a significant level of disagreement over the future price of fossil fuels, which are notoriously difficult to project due to the many factors that impact their price. Figure 3.2 illustrates the trend of fuel prices used in the Base Case.

Table 3.4 Primary Fuel Prices

Base Case Forecast Primary Fuel Prices (2000$/mmBtu)						
	1990-1999 Average	**2000**	**2005**	**2010**	**2015**	**2020**
Wellhead Price of Gas	2.16	4.86	2.27	2.53	2.63	2.74
Minemouth Price of Coal	1.01	0.79	0.69	0.65	0.62	0.59
World Price of Oil	3.55	5.20	3.54	3.62	3.72	3.80
	Cumulative Growth Rate (%)					
Wellhead Price of Gas	0.0%	16.2%	0.5%	1.0%	1.0%	0.9%
Minemouth Price of Coal	0.0%	-4.9%	-3.7%	-2.9%	-2.4%	-2.1%
World Price of Oil	0.0%	7.6%	0.0%	0.1%	0.2%	0.3%

Table 3.5 lists the values for New Hampshire's energy-related carbon dioxide (CO_2) emissions. As can be seen in the table, total energy-related CO_2 emissions are expected to increase at a rate of 2.2% annually over the forecast period. This is the same amount that our overall energy use is projected to

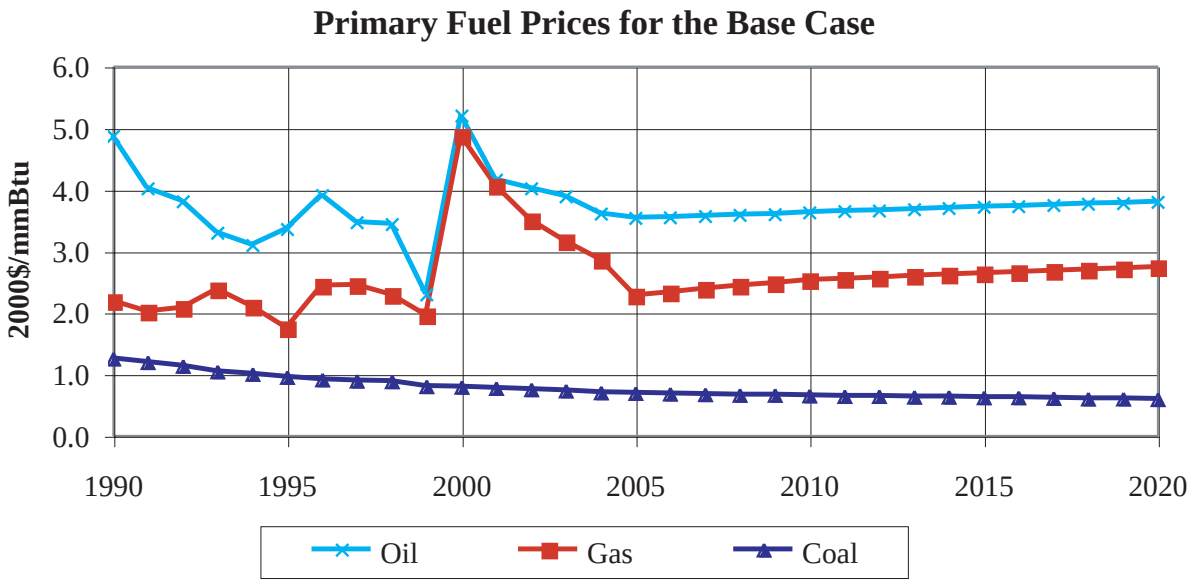

Figure 3.2 Primary Fuel Prices

Table 3.5 New Hampshire CO_2 Emissions (Million Tons CO_2e/Year)

Base Case Forecast New Hampshire CO2 Emissions (Million Tons CO2e/Year)						
	1995	**2000**	**2005**	**2010**	**2015**	**2020**
Residential	3.65	3.67	3.84	4.06	4.30	4.55
Commercial	1.24	1.37	1.60	1.81	2.01	2.20
Industrial	2.37	3.46	4.11	4.69	5.46	6.19
Transportation	5.73	7.04	8.77	10.05	11.47	12.90
Electric Utility	3.75	16.98	18.04	20.82	23.13	24.63
Total	**16.74**	**32.52**	**36.36**	**41.43**	**46.37**	**50.46**
			Cumulative Growth Rate			
Residential	0.1%	0.0%	0.9%	1.0%	1.0%	1.1%
Commercial	2.0%	0.0%	3.1%	2.8%	2.6%	2.4%
Industrial	7.6%	0.0%	3.5%	3.0%	3.0%	2.9%
Transportation	4.1%	0.0%	4.4%	3.6%	3.3%	3.0%
Electric Utility	30.2%	0.0%	1.2%	2.0%	2.1%	1.9%
Total	**13.3%**	**0.0%**	**2.2%**	**2.4%**	**2.4%**	**2.2%**

increase, so that under the "business as usual" forecast, our CO_2 emissions will continue at current rates. Consequently, if we remain on our current track, we will not be using cleaner energy over the next 20 years.

3.3 Residential Forecast

New Hampshire has approximately 1.2 million residents in the state's ten counties. According to the 2000 census, New Hampshire has 547,000 individual households. Most households in the state are single family. According to the ENERGY2020 model, New Hampshire's population is expected to grow by less than 1% annually through the year 2020.

In the residential forecast, demand grows moderately over the forecast period for each fuel. Table 3.6 summarizes the forecasted residential demand and growth rates. As shown in the summary table, total residential demand is projected to grow at an average rate of 1.3% between the years 2000 and 2020. This 1.3% growth in residential demand is slightly lower than growth of personal income, projected to be moderate at 1.7%. Residential demand grows at a slower rate than personal income due to higher levels of energy efficiency over time, a modest but positive outcome of our investments in energy efficiency.

With respect to specific fuels, ENERGY2020 projects that the growth of natural gas and electricity (1.9% and 2.0%) is higher than the growth of oil (0.9%) over the forecast period. This relationship reflects a higher market share for natural gas and electricity relative to oil.

Table 3.7 summarizes the forecast of residential demand for seven end uses. The end uses include space heating, water heating, refrigeration, lighting, air conditioning, other substitutable end uses and other non-substitutables. Other substitutable end uses include cooking and clothes drying, because several

Table 3.6 Residential Demand Summary

Base Case Forecast Residential Demand Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Personal Income						
1998 B$/Yr	30.539	39.862	43.652	47.955	52.220	56.303
Cumulative Growth Rate	2.7%	0.0%	1.8%	1.9%	1.8%	1.7%
Demand (Tbtu/Yr)						
Electric	11.752	12.740	13.985	15.809	17.654	19.134
Gas	5.986	6.906	7.442	8.197	9.074	10.070
Oil	21.100	28.920	29.996	31.555	33.121	34.667
Biomass	3.684	2.700	2.814	2.996	3.215	3.458
Solar	0.003	0.003	0.003	0.003	0.003	0.004
LPG	5.254	6.727	7.137	7.493	7.867	8.281
Total	**47.778**	**57.997**	**61.376**	**66.054**	**70.935**	**75.613**
Cumulative Demand Growth Rate						
Electric	0.8%	0.0%	1.9%	2.2%	2.2%	2.0%
Gas	1.4%	0.0%	1.5%	1.7%	1.8%	1.9%
Oil	3.2%	0.0%	0.7%	0.9%	0.9%	0.9%
Biomass	-3.1%	0.0%	0.8%	1.0%	1.2%	1.2%
Solar	0.2%	0.0%	0.4%	0.5%	0.8%	1.1%
LPG	2.5%	0.0%	1.2%	1.1%	1.0%	1.0%
Total	**1.9%**	**0.0%**	**1.1%**	**1.3%**	**1.3%**	**1.3%**

energy sources can be used for these activities, including gas and electricity. Other non-substitutables, which are those items that must use electricity, include computers, TVs, clothes washers, and other electrical devices. All end uses are projected to grow moderately over the forecast period. The demand grows most significantly for other substitutables (1.9%), lighting (1.7%), and water heating (1.5%). Air conditioning (1.0%) and refrigeration (1.0%) have lower growth rates due to the impact of efficiency standards for these two end uses.

Between 2000 and 2010, residential electric prices are projected to decline at an average annual growth rate of –2.85%. By 2020, the average growth steadies at –.45%. Residential prices of gas, oil, biomass, and LPG remain relatively flat through 2020. Figure 3.3 shows the residential energy prices

Table 3.7 Residential End Use Demand Summary

Base Case Forecast Residential Enduse Demand Summary	1990	2000	2005	2010	2015	2020
Personal Income						
1998 B$/Yr	30.54	39.86	43.65	47.95	52.22	56.30
Cumulative Growth Rate	2.7%	0.0%	1.8%	1.9%	1.8%	1.7%
Demand (Tbtu/Yr)						
Space Heating	26.35	29.18	30.47	32.47	34.60	36.65
Water Heating	11.73	17.32	18.66	20.29	21.92	23.54
Other Subs	2.72	3.84	4.24	4.71	5.16	5.57
Refrigeration	3.32	3.71	3.81	4.01	4.25	4.50
Lighting	0.76	0.81	0.86	0.94	1.06	1.14
Air Condition	0.54	0.60	0.60	0.64	0.69	0.73
Other Non-Subs	2.36	2.53	2.74	3.00	3.26	3.50
Total	**47.78**	**58.00**	**61.38**	**66.06**	**70.94**	**75.62**
Cumulative Demand Growth Rate						
Space Heating	1.0%	0.0%	0.9%	1.1%	1.1%	1.1%
Water Heating	3.9%	0.0%	1.5%	1.6%	1.6%	1.5%
Other Subs	3.4%	0.0%	2.0%	2.0%	2.0%	1.9%
Refrigeration	1.1%	0.0%	0.5%	0.8%	0.9%	1.0%
Lighting	0.7%	0.0%	1.0%	1.5%	1.8%	1.7%
Air Condition	1.1%	0.0%	0.1%	0.6%	1.0%	1.0%
Other Non-Subs	0.7%	0.0%	1.6%	1.7%	1.7%	1.6%
Total	**1.9%**	**0.0%**	**1.1%**	**1.3%**	**1.3%**	**1.3%**

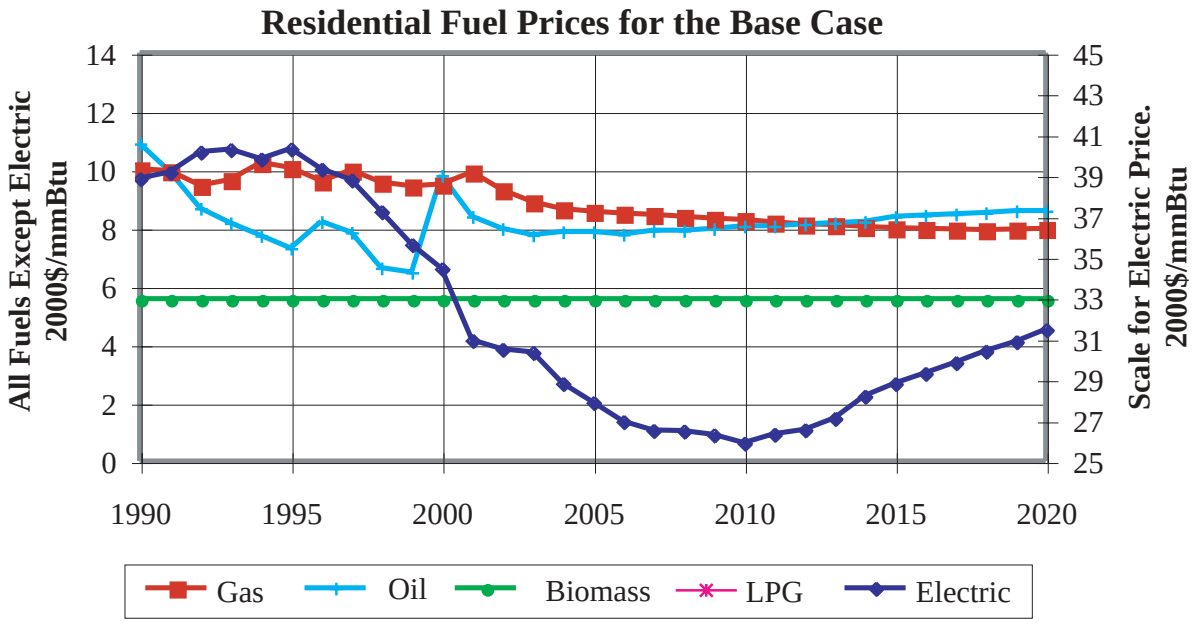

Figure 3.8 Residential Fuel Prices

Table 3.8 Residential Energy Prices

Base Case Forecast Residential Energy Prices (2000 $/mmBtu)						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Electric	38.84	34.44	27.87	25.89	28.82	31.46
Gas	10.03	9.49	8.57	8.28	8.00	7.98
Oil	10.88	9.80	7.88	8.06	8.39	8.58
Biomass	5.57	5.57	5.57	5.57	5.57	5.57
Solar	38.84	34.44	27.87	25.89	28.82	31.46
LPG	17.72	17.23	17.39	17.57	17.20	17.10
	Cumulative Growth Rate					
Electric	-1.20%	0.00%	-4.23%	-2.85%	-1.19%	-0.45%
Gas	-0.55%	0.00%	-2.06%	-1.37%	-1.14%	-0.87%
Oil	-1.05%	0.00%	-4.36%	-1.95%	-1.04%	-0.66%
Biomass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Solar	-1.20%	0.00%	-4.23%	-2.85%	-1.19%	-0.45%
LPG	-0.28%	0.00%	0.19%	0.20%	-0.01%	-0.04%

by fuel and Table 3.8 summarizes the forecasted prices and their growth rates.

Overall, in the Base Case or "business as usual" forecast, prices for residential customers remain stable over the entire forecast horizon.

3.4 Commercial Forecast

New Hampshire has a strong commercial sector, with a significant presence in all parts of the state. Major commercial sectors in New Hampshire include retail establishments, computer programming and

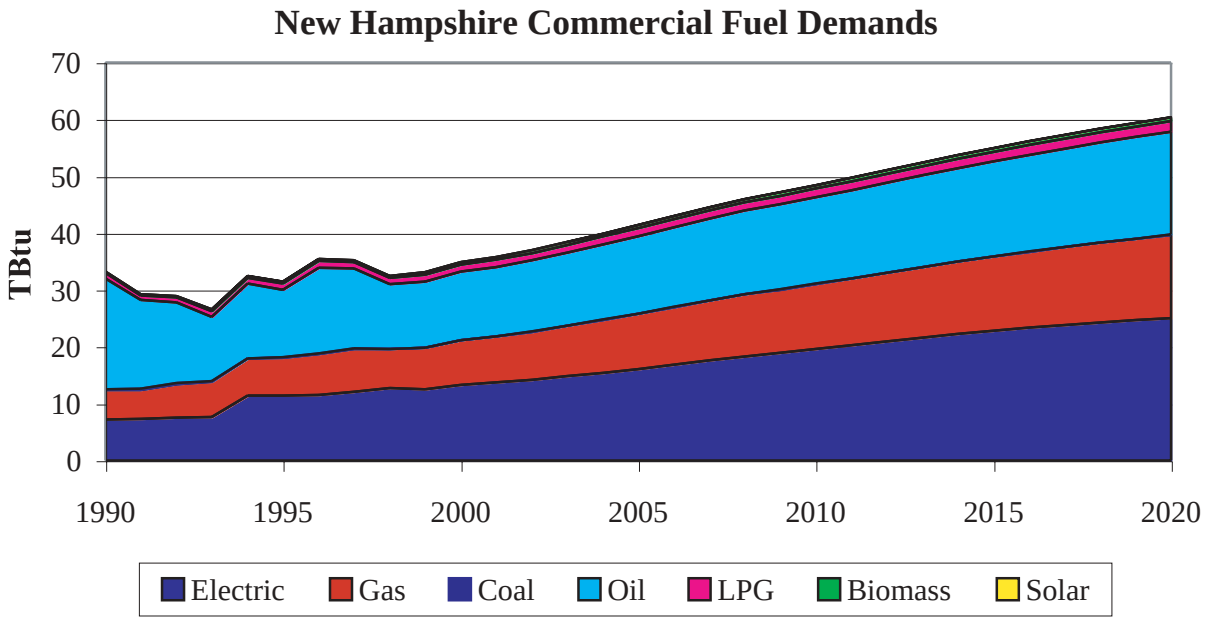

Figure 3.3 New Hampshire Commercial Fuel Demands

related services, health services, and other non-manufacturing professional activities.

Figure 3.4 illustrates the forecast of commercial demand by fuel type. Table 3.9 summarizes the forecasted demands and growth rates. As listed in Table 3.9, total commercial demand is expected to grow at a rate of 2.7% over the forecast period. The growth of commercial economic output is slightly less at 2.6%. The higher growth in energy usage is due to an increase in energy used by the commercial sector per dollar of output, which suggests that the commercial sector will actually become less efficient in our

Table 3.9. Commercial Demand Summary

Base Case Forecast Commercial Demand Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Economic Output						
1998 B$/Yr	38.496	55.837	65.267	74.856	84.189	92.950
Cumulative Growth Rate	3.7%	0.0%	3.1%	2.9%	2.7%	2.6%
Demand (Tbtu/Yr)						
Electric	7.22	13.34	16.08	19.60	22.83	25.08
Gas	5.14	7.81	9.73	11.44	13.04	14.59
Coal	0.13	0.04	0.04	0.04	0.04	0.04
Oil	19.55	12.02	13.61	15.21	16.69	18.13
Biomass	0.23	0.43	0.52	0.59	0.64	0.70
Solar	0.00	0.00	0.00	0.00	0.00	0.00
LPG	0.93	1.25	1.43	1.55	1.69	1.85
Total	**33.20**	**34.90**	**41.41**	**48.43**	**54.94**	**60.39**
Cumulative Demand Growth Rate						
Electric	6.1%	0.0%	3.7%	3.9%	3.6%	3.2%
Gas	4.2%	0.0%	4.4%	3.8%	3.4%	3.1%
Coal	-11.1%	0.0%	-1.0%	-1.1%	-0.8%	-0.5%
Oil	-4.9%	0.0%	2.5%	2.4%	2.2%	2.1%
Biomass	6.1%	0.0%	3.7%	3.0%	2.7%	2.4%
Solar	-0.6%	0.0%	-0.3%	-2.7%	-2.1%	-0.3%
LPG	3.0%	0.0%	2.7%	2.2%	2.0%	2.0%
Total	**0.5%**	**0.0%**	**3.4%**	**3.3%**	**3.0%**	**2.7%**

"business as usual" forecast unless polices or programs are created to increase efficiency.

The forecast of commercial demand indicates a shifting of dominant fuels over the forecast period. Consistent with the overall forecast, the historically dominant fuel, which is oil (2.1% growth), shifts to both natural gas (3.1% growth) and electricity (3.2% growth).

Table 3.10 summarizes commercial demand, showing moderate growth in the seven end uses. Air conditioning demand grows the most at a rate of 3.4%; lighting sees the slowest growth at 2.0%, showing the impacts of efficiency investments. Commercial energy prices are projected to decline overall. The Base Case projects electric prices to decline in the short term, and then begin to grow after 2009, resulting in an overall modest decline. By 2020, the average annual growth rate of commercial electric prices is –.72%.

Table 3.10 Commercial Enduse Demand Summary

Base Case Forecast Commercial Enduse Demand Summary	1990	2000	2005	2010	2015	2020
Economic Output						
1998 B$/Yr	38.50	55.84	65.27	74.86	84.19	92.95
Cumulative Growth Rate	3.7%	0.0%	3.1%	2.9%	2.7%	2.6%
Demand (Tbtu/Yr)						
Space Heating	17.97	20.42	24.54	28.92	32.93	36.23
Water Heating	1.21	1.39	1.59	1.78	1.95	2.13
Other Subs	0.11	0.18	0.22	0.25	0.29	0.32
Refrigeration	0.44	0.83	1.00	1.19	1.35	1.49
Lighting	3.42	6.18	6.92	7.70	8.45	9.26
Air Condition	1.93	3.60	4.44	5.49	6.47	7.11
Other Non-Subs	0.15	0.28	0.34	0.39	0.44	0.49
Feedstocks	7.95	2.02	2.36	2.71	3.05	3.37
Total	**33.20**	**34.90**	**41.41**	**48.43**	**54.94**	**60.39**
Cumulative Demand Growth Rate						
Space Heating	1.3%	0.0%	3.7%	3.5%	3.2%	2.9%
Water Heating	1.3%	0.0%	2.8%	2.5%	2.3%	2.2%
Other Subs	5.0%	0.0%	3.4%	3.2%	3.0%	2.7%
Refrigeration	6.2%	0.0%	3.9%	3.6%	3.3%	3.0%
Lighting	5.9%	0.0%	2.3%	2.2%	2.1%	2.0%
Air Condition	6.2%	0.0%	4.2%	4.2%	3.9%	3.4%
Other Non-Subs	6.2%	0.0%	3.6%	3.4%	3.1%	2.8%
Feedstocks	-13.7%	0.0%	3.1%	2.9%	2.7%	2.5%
Total	**0.5%**	**0.0%**	**3.4%**	**3.3%**	**3.0%**	**2.7%**

The non-electric prices show no change or a slight decline through 2020. Commercial natural gas prices decline by –0.43, while commercial oil prices decline by –0.62%. Table 3.11 summarizes the forecast of commercial energy prices, and Figure 3.5 illustrates the relationship among the fuel prices.

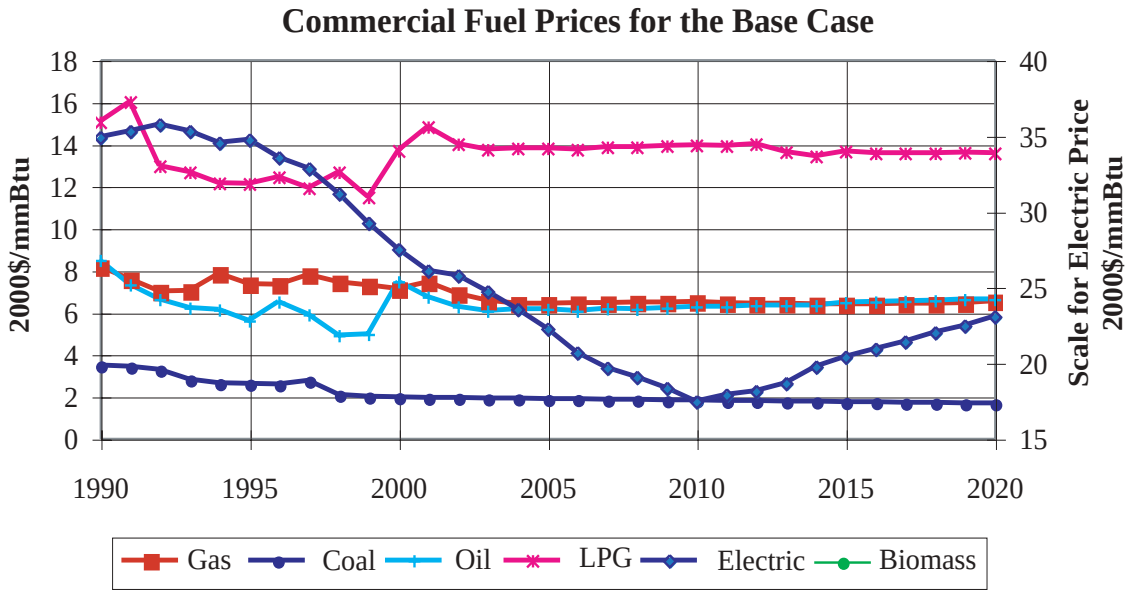

Figure 3.5 Commercial Energy Prices

Table 3.11 Commercial Energy Prices

Base Case Forecast Commercial Energy Prices (2000 $/mmBtu)						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Electric	34.89	27.47	22.22	17.44	20.37	23.03
Gas	8.14	7.09	6.39	6.48	6.36	6.50
Coal	3.47	1.96	1.87	1.79	1.72	1.65
Oil	8.46	7.46	6.12	6.26	6.46	6.59
Biomass	4.14	4.14	4.14	4.14	4.14	4.14
Solar	34.89	27.47	22.22	17.44	20.37	23.03
LPG	15.04	13.66	13.79	13.93	13.63	13.56
	Cumulative Growth Rate					
Electric	-2.39%	0.00%	-4.24%	-4.55%	-1.99%	-0.88%
Gas	-1.39%	0.00%	-2.06%	-0.90%	-0.72%	-0.43%
Coal	-5.72%	0.00%	-0.90%	-0.87%	-0.87%	-0.85%
Oil	-1.27%	0.00%	-3.94%	-1.75%	-0.96%	-0.62%
Biomass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Solar	-2.39%	0.00%	-4.24%	-4.55%	-1.99%	-0.88%
LPG	-0.96%	0.00%	0.19%	0.20%	-0.01%	-0.04%

3.5 Industrial Forecast

New Hampshire has a strong and diverse industrial sector, with no single industry dominating. Some of the major energy users in the industrial sector include paper mills, machine and computer manufacturing, and electronic equipment manufacturing.

Overall energy demand of industrial customers is expected to increase at an average annual growth rate of 2.6%, while industrial output grows at 4.2%. This difference is largely due to the higher growth in economic output in the less energy intensive industries.

Electricity demand is expected to follow overall economic growth at a rate of 4.2%. These industries, such as the manufacturing of machines and electric equipment, although less energy intensive overall, still use a significant amount of electricity. Table 3.12 summarizes the forecast of industrial demand.

Industrial energy growth is dominated by two industries, Machines & Equipment (SIC 35) and Electric Equipment (SIC 36). The energy growth reflects the economic growth in these industries. Table 3.13 details the forecasted demand by industry.

Table 3.14 summarizes the forecast of industrial prices. As shown in Table 3.14, industrial energy prices drop in the early years. Electricity prices increase in later years producing a slight (0.22%) increase by 2020. Gas and oil prices also recover somewhat but still show a long-term (–0.94%) reduction.

Table 3.12 Industrial Demand Summary

Base Case Forecast Industrial Demand Summary						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Economic Output						
1998 B$/Yr	16.199	37.513	49.391	60.070	72.987	85.957
Cumulative Growth Rate	8.4%	0.0%	5.5%	4.7%	4.4%	4.2%
Demand (Tbtu/Yr)						
Electric	11.66	8.99	11.89	15.51	19.08	21.42
Gas	3.32	6.47	8.76	10.82	13.33	15.45
Coal	0.70	0.00	0.00	0.00	0.00	0.00
Oil	7.14	24.50	29.71	34.46	40.05	45.23
Biomass	19.79	32.06	33.79	34.48	37.29	40.23
Solar	0.00	0.00	0.00	0.00	0.00	0.00
LPG	1.46	1.02	1.04	1.12	1.31	1.52
Total	**44.07**	**73.03**	**85.18**	**96.38**	**111.06**	**123.85**
Cumulative Demand Growth Rate						
Electric	-2.6%	0.0%	5.6%	5.5%	5.0%	4.3%
Gas	6.7%	0.0%	6.1%	5.2%	4.8%	4.4%
Coal	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oil	12.3%	0.0%	3.9%	3.4%	3.3%	3.1%
Biomass	4.8%	0.0%	1.1%	0.7%	1.0%	1.1%
Solar	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
LPG	-3.6%	0.0%	0.4%	0.9%	1.7%	2.0%
Total	**5.1%**	**0.0%**	**3.1%**	**2.8%**	**2.8%**	**2.6%**

3.6 Transportation Forecast

The legislation that mandated development of the New Hampshire Energy Plan, House Bill 443, did not call for an analysis of energy use in transportation. However, transportation is a major component of the state's energy use, and is larger than industrial, commercial or residential use. In addition, energy use for transportation is expected to grow more than any other type of use, making it an increasingly important issue in the state's future energy planning efforts.

Because it is an important part of energy use in all states and regions, the ENERGY2020 model used in developing information for this energy plan evaluates transportation energy use. While we do not focus on this issue, we present the information generated by ENERGY2020 so that policy makers and stakeholders have information available for future discussions.

Table 3.15 summarizes the forecast of transportation demands. Total transportation demand is expected to grow at a rate of 3.0% over the forecast period. Automobiles continue to be the dominant mode of transportation, with the largest demand of any sector and a growth rate of 3.0%. Train and marine modes, while having small demands, have the highest projected growth rates, 5.3% and 5.2% respectively.

Table 3.16 summarizes the forecasted transportation energy prices and growth rates, which shows

Table 3.13 Industrial Demand Summary by Industry

Base Case Forecast Industrial Demand Summary by Industry	1990	2000	2005	2010	2015	2020
Economic Output						
1998 B$/Yr						
SIC 26 Paper	1.10	1.13	1.12	1.17	1.29	1.41
SIC 35 Machines & Computer	3.27	13.50	21.60	28.51	35.96	43.48
SIC 36 Electric Equipment	1.73	6.89	10.14	13.15	16.22	19.08
SIC 29 Petroleum Products	0.03	0.47	0.49	0.48	0.50	0.53
SIC 30 Rubber	1.03	1.66	1.76	1.95	2.23	2.52
SIC 33 Primary Metals	0.65	1.48	1.57	1.68	2.07	2.50
SIC 38 Instruments	1.92	2.30	2.60	2.84	3.51	4.22
Rest of Industries	6.46	10.08	10.11	10.29	11.20	12.23
Total Industries	16.20	37.51	49.39	60.07	72.99	85.96
Cumulative Growth Rate						
SIC 20 Food & Tobacco	0.2%	0.0%	-0.1%	0.4%	0.9%	1.1%
SIC 30 Rubber	14.2%	0.0%	9.4%	7.5%	6.5%	5.8%
SIC 33 Primary Metals	13.8%	0.0%	7.7%	6.5%	5.7%	5.1%
SIC 35 Machines & Computer	26.5%	0.0%	0.9%	0.1%	0.4%	0.6%
SIC 36 Electric Equipment	4.8%	0.0%	1.2%	1.6%	2.0%	2.1%
SIC 37 Transport Equipment	8.2%	0.0%	1.3%	1.3%	2.2%	2.6%
SIC 38 Instruments	1.8%	0.0%	2.4%	2.1%	2.8%	3.0%
Rest of Industries	4.4%	0.0%	0.1%	0.2%	0.7%	1.0%
Total Industries	8.4%	0.0%	5.5%	4.7%	4.4%	4.1%
Demand (Tbtu/Yr)						
SIC 26 Paper	23.91	21.78	22.63	24.28	26.68	28.65
SIC 35 Machines & Computer	2.08	5.97	10.17	13.91	17.58	20.88
SIC 36 Electric Equipment	1.29	6.82	10.99	14.97	18.64	21.62
SIC 29 Petroleum Products	0.66	16.55	17.39	16.85	17.75	18.77
SIC 30 Rubber	1.22	2.74	3.21	3.80	4.39	4.86
SIC 33 Primary Metals	2.33	3.11	3.42	3.78	4.74	5.64
SIC 38 Instruments	1.36	1.89	2.41	2.87	3.76	4.62
Rest of Industries	11.22	14.18	14.95	15.93	17.52	18.82
Total Industries	44.07	73.03	85.18	96.38	111.06	123.85
Cumulative Demand Growth Rate						
SIC 26 Paper	-0.9%	0.0%	0.8%	1.1%	1.4%	1.4%
SIC 35 Machines & Computer	10.5%	0.0%	10.7%	8.5%	7.2%	6.3%
SIC 36 Electric Equipment	16.6%	0.0%	9.5%	7.9%	6.7%	5.8%
SIC 29 Petroleum Products	32.3%	0.0%	1.0%	0.2%	0.5%	0.6%
SIC 30 Rubber	8.1%	0.0%	3.2%	3.3%	3.1%	2.9%
SIC 33 Primary Metals	2.9%	0.0%	1.9%	1.9%	2.8%	3.0%
SIC 38 Instruments	3.3%	0.0%	4.8%	4.2%	4.6%	4.5%
Rest of Industries	2.3%	0.0%	1.1%	1.2%	1.4%	1.4%
Total Industries	5.1%	0.0%	3.1%	2.8%	2.8%	2.6%

that the energy prices experience an overall decline over the forecast period. The highway (automobile) price, the largest of the five transportation modes, decreases at an average rate of –0.70%. The marine energy price is the smallest price and declines at an average rate of –1.5%.

The New Hampshire Department of Transportation (NHDOT) is charged with developing Ten Year Transportation Plans under federal law, which serve as the State's transportation plan. The current plan, covering the years 2003 through 2012, provides a strong foundation for increasing the use of inter-modal transportation statewide. The Plan focuses on the infrastructure necessary to support reliable

Table 3.14 Industrial Energy Prices

Base Case Forecast Industrial Energy Prices (2000 $/mmBtu)						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Electric	29.30	23.23	19.25	18.58	21.62	24.27
Gas	5.31	5.25	3.95	3.99	4.03	4.35
Coal	3.47	0.00	0.00	0.00	0.00	0.00
Oil	8.90	5.04	3.95	3.97	4.07	4.18
Biomass	4.14	4.14	4.14	4.14	4.14	4.14
LPG	15.04	13.66	13.79	13.93	13.63	13.56
			Cumulative Growth Rate			
Electric	-2.32%	0.00%	-3.76%	-2.23%	-0.48%	0.22%
Gas	-0.12%	0.00%	-5.69%	-2.75%	-1.76%	-0.94%
Coal	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Oil	-5.68%	0.00%	-4.90%	-2.39%	-1.42%	-0.94%
Biomass	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
LPG	-0.96%	0.00%	0.19%	0.20%	-0.01%	-0.04%

intermodal transportation, including highways, bridges, rail, air, bicycle and pedestrian facilities. It does not, however, focus on energy use, efficiency, or alternative energy in the transportation system.

Table 3.15 Transportation Demand Summary

Base Case Forecast Transportation Demand Summary						
	1990	2000	2005	2010	2015	2020
Economic Output						
Residential						
1998 B$/Yr	30.54	39.86	43.65	47.95	52.22	56.30
Cumulative Growth Rate	2.7%	0.0%	1.8%	1.9%	1.8%	1.7%
Commercial						
1998 B$/Yr	38.50	55.84	65.27	74.86	84.19	92.95
Cumulative Growth Rate	3.7%	0.0%	3.1%	2.9%	2.7%	2.6%
Industrial						
1998 B$/Yr	16.20	37.51	49.39	60.07	72.99	85.96
Cumulative Growth Rate	8.4%	0.0%	5.5%	4.7%	4.4%	4.2%
Demand (Tbtu/Yr)						
Highway	69.44	94.24	116.96	133.59	152.20	170.98
Bus	0.00	0.01	0.01	0.01	0.01	0.01
Train	0.03	0.05	0.07	0.09	0.12	0.15
Plane	3.68	4.66	5.72	6.61	7.41	8.15
Marine	0.03	0.06	0.08	0.11	0.14	0.17
Total	**73.18**	**99.02**	**122.85**	**140.42**	**159.88**	**179.45**
Cumulative Demand Growth Rate						
Highway	3.1%	0.0%	4.3%	3.5%	3.2%	3.0%
Bus	8.0%	0.0%	4.3%	3.2%	2.6%	2.3%
Train	6.6%	0.0%	7.7%	6.2%	5.7%	5.3%
Plane	2.4%	0.0%	4.1%	3.5%	3.1%	2.8%
Marine	5.4%	0.0%	7.1%	6.0%	5.6%	5.2%
Total	**3.0%**	**0.0%**	**4.3%**	**3.5%**	**3.2%**	**3.0%**

See Chapter 10 for more information on the state's transportation energy use and opportunities to increase efficiency and use alternative fuels.

Table 3.16 Transportation Energy Prices

Base Case Forecast Transportation Energy Prices (2000 $/mmBtu)						
	1990	**2000**	**2005**	**2010**	**2015**	**2020**
Highway	12.62	13.04	11.36	11.53	11.43	11.35
Bus	12.42	11.77	9.98	10.03	10.16	10.11
Train	12.42	11.77	9.98	10.03	10.16	10.11
Plane	7.73	5.94	4.93	5.04	5.18	5.30
Marine	3.23	3.77	2.62	2.62	2.71	2.80
			Cumulative Growth Rate			
Highway	0.33%	0.00%	-2.77%	-1.24%	-0.88%	-0.70%
Bus	-0.54%	0.00%	-3.30%	-1.59%	-0.98%	-0.76%
Train	-0.54%	0.00%	-3.30%	-1.59%	-0.98%	-0.76%
Plane	-2.63%	0.00%	-3.74%	-1.64%	-0.92%	-0.57%
Marine	1.55%	0.00%	-7.26%	-3.65%	-2.21%	-1.50%

In order to provide a more integrated approach to transportation planning with an appropriate focus on the energy impacts of our transportation choices, the Governor's Office of Energy & Community Services and the Department of Environmental Services should increase efforts to collaborate with NHDOT to ensure that they have the latest information on energy use and fuel efficiency as it relates to transportation. As discussed in Chapter 1, we have recommended that NHDOT serve on an Energy Planning Advisory Board to ensure that transportation issues are considered in the State's future energy planning efforts.

3.7 Alternative "High Price" Scenario

At the suggestion of stakeholders and members of the public, a second hypothetical scenario was developed to understand how New Hampshire's energy use, economic development, and environment would be impacted by a steep climb in fossil fuel prices. It was suggested that, while the Base Case provides valuable baseline information for decision-makers, it would be very helpful to also evaluate the effects of unforeseen increases in fossil fuel prices as the result of geopolitical events, resource shortages, or other reasons.

Energy forecasting is a difficult undertaking, with many variables that are likely to change rapidly. As a result, the primary value of a policy simulation model such as ENERGY2020 or REMI lies not in its ability to "predict the future," but rather in its ability to estimate how potential policies would change future outcomes of interest to the state, relative to what would have happened without the particular policy. As discussed above, the Base Case forecast is an attempt to project a most likely or "best guess" future of the energy and economic system in New Hampshire, for the purposes of stimulating ideas for potential policies, and testing for the impacts of potential policies.

Some projections of changes that help shape the Base Case scenario are quite safe assumptions. For example, both the state population and the energy efficiency of the existing building stocks change slowly over time, so our projections of their values over the next 10 and even 20 years are likely to be accurate within a few percentage points. In contrast, several other key determinants of the Base Case energy forecast are notoriously difficult to predict. The most uncertain elements are future world prices of fossil fuels. As history has shown, unpredictable world events can lead to rapid and major changes in these prices, over the short or even long term. And over the long term, such prices have a strong influence on the decisions of people and businesses as they invest in energy-using devices and capital stocks.

For these reasons, it was suggested during the early series of meetings and discussions with stakeholders that it would be beneficial to the planning process to create and utilize a hypothetical alternative forecast of world fossil fuel energy prices. The purpose is not to provide a second "prediction" of fossil fuel prices, but instead to create a possible, albeit purely hypothetical, alternative view of fuel prices against which to test potential policies. This alternative price forecast allows us to see the impact of policies against both the flat EIA-based projections, as well as against a hypothetical price spike event that could occur for a variety of reasons.

As shown above in Figures 3.5 and 3.6, the Base Case forecast for fossil fuel prices from EIA is very stable and calls for gradually falling real prices over the next 20 years. During the past 30 years, fossil fuel prices have shown periods of great volatility, due largely to geopolitical events. It was determined that the policy test simulations conducted to support the energy plan should also investigate the

sensitivity of conclusions to a scenario in which fossil fuel prices followed historical patterns of volatility in addition to the EIA projections of stability and modest decline. The next section summarizes the alternative fossil fuel price scenario that was developed, and the effects of these alternative fossil fuel prices upon key variables relative to the Base Case forecast.

3.7.1 High Price Scenario Definition

Rather than attempt to provide an "alternative forecast" of fossil fuel prices, we decided to simply create an alternative price scenario, in which price dynamics followed a pattern similar to those seen in recent history. Therefore, it is important to understand that this scenario is not meant to be a statement about, or forecast of, expected prices; instead, it is intended to provide a set of hypothetical prices against which the impacts of policies can be tested. The high price scenario is intended to provide a fossil fuel price scenario that is significantly different from the Base Case price scenario for the purpose of understanding policy impacts in different circumstances.

The benefit of this alternative scenario is that it provides more context for the potential policies that are tested in the model, as it can demonstrate whether the effects of potential policies depend significantly upon which of the fossil fuel price scenarios is used. If impacts of a policy are shown to depend strongly upon which fossil fuel price scenario is used, this indicates that policy makers should exercise caution in relying on the policy results to turn out in the way that any single scenario determines, because historically fossil fuel price forecasts have been inherently uncertain.

Historical price data are available from the EIA's State Energy Data System (SEDS). For the SEDS use category of "total energy consumption," real (that is, inflation-corrected) prices (per Million Btu) for coal, natural gas, and "all petroleum fuels" relative to their values in 1978 are plotted in Figure 6. It is interesting to note that natural gas prices actually rose higher relative to their 1978 price than did the aggregated set of all petroleum fuels. Specifically, crude oil prices climbed to a value just over two times their 1978 levels by 1981, and then slowly and gradually declined. Natural gas prices continued to rise through 1983, reaching a peak value nearly 3 times their 1978 level, after which they too declined. By 1990, both gas and oil prices were not far from twice their 1978 values.

Based on this information, the average deviation of natural gas and petroleum product price factors from 1978 to 1990 (per Million Btu, relative to 1978, in real dollars) was calculated as shown in Figure 3.7. These factors were then used to scale EIA's forecast of natural gas and each petroleum fuel's cost (per Million Btu, in real dollars) for the period 2008 – 2020, in order to create the "high price" (HP) scenario.

3.7.2 High Price Scenario Impacts

The hypothetical rise (and fall) in fossil fuel prices that was tested would have a variety of effects on some key variables, relative to the Base Case forecast, as summarized in Figure 3.8. The demand, at point of end-use, for fuels other than natural gas and electricity (primarily petroleum fuels) drops sharply

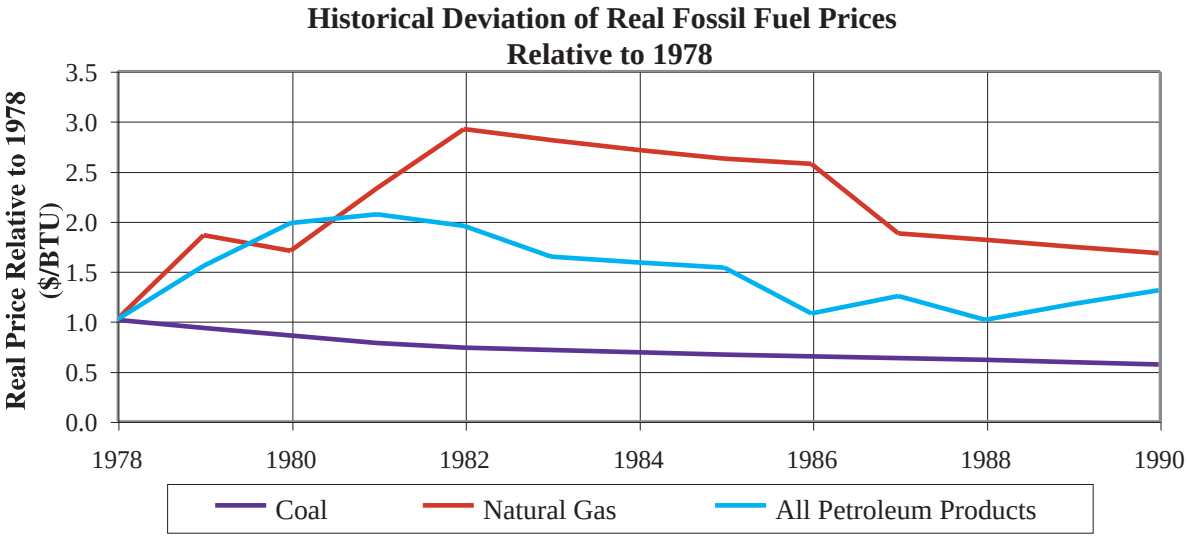

Figure 3.6 Historical deviation of real fossil fuel prices relative to 1978

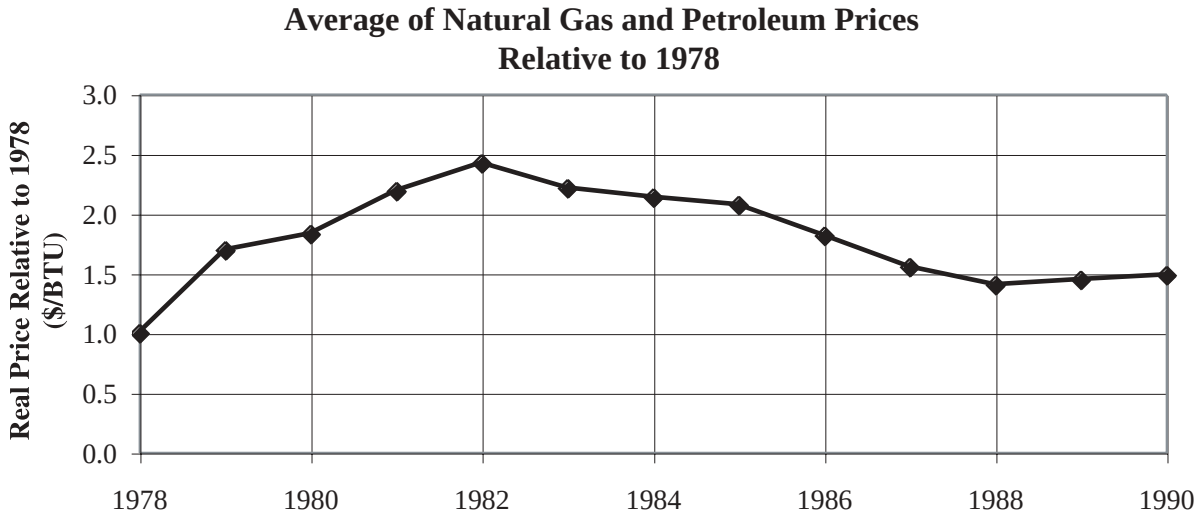

Figure 3.7 Price scaling factors to use for the forecast period 2008 – 2020,

after the price begins to rise. This shift away from petroleum (and natural gas) at point of use continues to grow even after the fossil fuel prices begin dropping again, because it takes time for capital for natural gas and all petroleum fuels to turn over (and for customers who are able to change fuels to do so), and because fossil fuel prices remain above those in the base case from 2009 onwards.

The shift away from natural gas and petroleum serves to increase the demand for electricity, as summarized in Figure 3.8 and Table 3.17. However, the resulting increase in electricity generation is likely to come largely from electric power stations whose fuel is natural gas. The resulting increase in natural gas consumption by the electric utility industry is greater than the reduction in natural gas consumption at the point of end-use, which results in a net increase in the use of natural gas. These users are not likely to switch to petroleum fuels (oil, diesel, or LPG) because their prices have also risen by the same factor as that of natural gas. For many end-uses, neither coal nor biomass are viable alternative fuels. Most users of gas and oil will either invest in greater efficiency or switch to electricity, whose price has not increased by the same factor as the prices of natural gas and petroleum.

The increased electricity generation also drives up the price for electricity (although not as high as petroleum as discussed above) as summarized in Figure 3.8 and Table 3.18. Note that wholesale electricity prices rise even more (in percentage terms relative to their base case levels) than average retail electricity prices. This higher wholesale price level is not enough of a jump, however, to stimulate earlier additions of new electricity generation capacity in New England relative to new additions forecast in the Base Case, as reflected by the line for "N.E. New Construction" in Figure 3.8. As a result, under this scenario, as with the Base Case, no new plants are forecast until 2019.

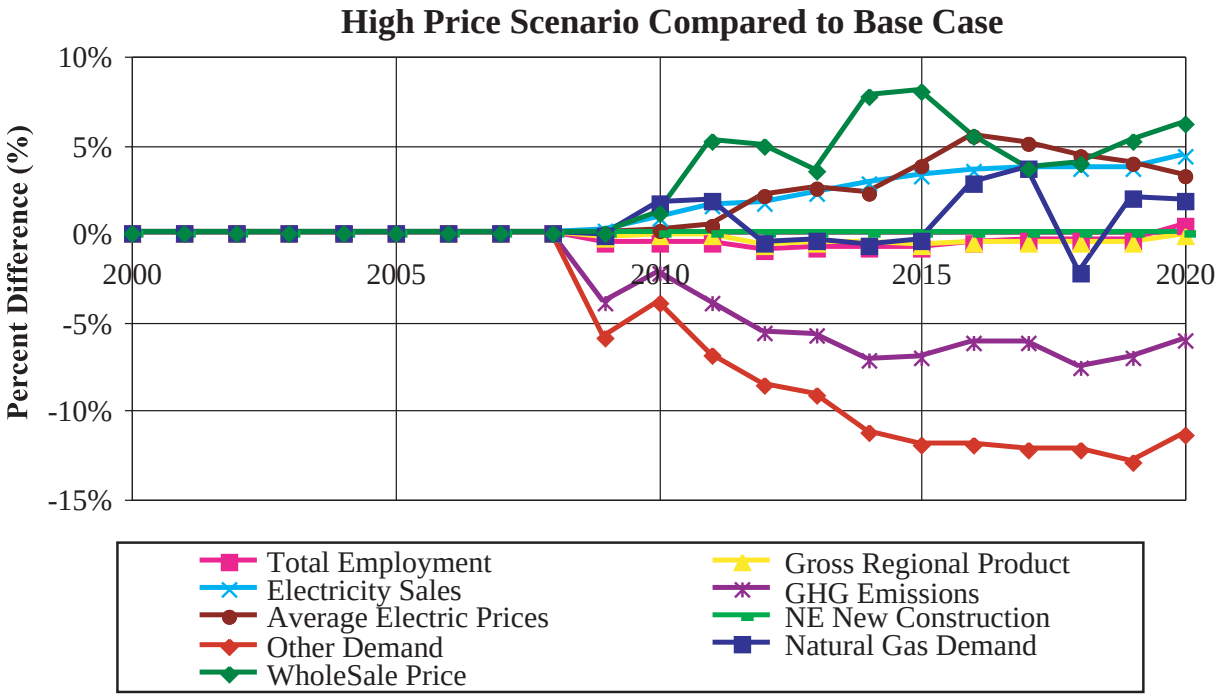

Figure 3.8 Effect of High Price Scenario on Key Variables, Relative to Base Case

Table 3.17 Changes in NH Electricity Sales Due to High Fossil Fuel Price Scenario

New Hampshire Electricity Sales (GWh/Year)						
	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	10,405	12,422	15,048	17,585	19,364	**15,199**
High Price	10,405	12,422	15,173	18,156	20,205	**15,481**
Difference	0	0	125	571	841	**281**
Percent Change	0.00%	0.00%	0.83%	3.25%	4.35%	**1.85%**

Table 3.18 Changes in NH Electricity Prices Due to High Fossil Fuel Price Scenario

Average Electric Prices (2000 $/MWh)						
	2000	2005	2010	2015	2020	20 Year Average
Base Case Comparison						
Base Case	98.67	79.38	69.65	79.42	88.35	**79.61**
High Price	98.67	79.38	69.73	82.42	91.18	**80.97**
Difference	0.00	0.00	0.09	3.00	2.83	**1.36**
Percent Change	0.00%	0.00%	0.13%	3.77%	3.20%	**1.60%**